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Construction Engineering Research Laboratory

GRASS Hardware Configurations Guide

by
Douglas Brooks
Michael Higgins
Mark Johnson

The Geographic Resources Analysis Support System (GRASS) is a geographic information and image processing system originally designed to serve land managers and environment planners at Army installations. GRASS is written in "C" and operates on computers running UNIX. Since its initial development, GRASS has been used for many applications on a number of different hardware configurations.

This Guide contains information to aid the user in configuring a hardware system that will support the implementation and use of GRASS software. Included are minimum hardware specifications that have been tested and are fully supported, and information on systems currently supported by an authorized GRASS support center that have successfully completed a beta test as outlined by the U.S. Army Construction Engineering Research Laboratory (USACERL). Also included is information on peripheral and performance options compatible with GRASS hardware configurations, and a listing of GRASS support centers and the computer systems and/or agencies that they support.

This Guide is not meant as an endorsement of the products or tradenames listed within, but only as a reference for the user considering hardware upon which to run GRASS.

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The Geographic Resources Analysis Support System (GRASS) is a geographic information and image processing system originally designed to serve land managers and environment planners at Army installations. GRASS is written in "C" and is ported between computers running the UNIX system. Since its initial development, GRASS has been developed for many applications on a number of different hardware configurations.

This Guide contains information to aid the user in configuring a hardware system that will support the implementation and use of GRASS software and data structures. Included are minimum hardware specifications that have been tested and are fully supported, and information on systems currently supported by an authorized GRASS support center that have successfully completed a Beta test as outlined by the U.S. Army Construction Engineering Research Laboratory (USACERL). Also included is information on peripheral and performance options compatible with GRASS hardware configurations, and a listing of GRASS Support Centers and the computer systems and/or agencies that they support.

This Guide is not meant as an endorsement of the products or tradenames listed within, but only as a reference for the user considering hardware upon which to run GRASS.

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FOREWORD

This work was sponsored by the USDA Soil Conservation Service (SCS) under their program, "Cooperative Development and Support of GRASS Between USACERL and SCS"; Work Unit ZP9:R-FED-SCS, "GRASS-SCS." The Soil Conservation Service Technical Monitor was Dr. Richard Liston.

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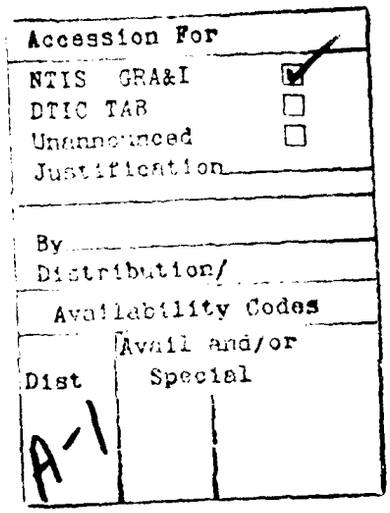

GRASS
Hardware Configuration Guide

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ABSTRACT

This document contains information to be used as a reference when implementing GRASS (Geographic Resources Analysis Support System) software. Minimum specifications are listed that your hardware should have in order to run the GRASS.

Various models have been researched by the U.S. Army Construction Engineering Research Laboratory (USACERL) and have been included in this document. The models listed in this guide are the particular configurations that have been tested and are now fully supported. Also included in this guide are peripherals that you can add to your system.

This guide is not intended as an endorsement of the products contained within but is meant to be used as a reference when considering hardware with which to run GRASS.

Every effort has been made to provide accurate product information and pricing, but please consider this document only as a guide. Due to the nature of the Electronics Industry and the constantly changing status of hardware that is available, this document changes frequently. A revision date is printed at the bottom of each page to give you an accurate publishing date. You may contact the GRASS Information Center to determine if a newer version of this document has been printed. When purchasing hardware, please contact your sales representative to verify pricing.

If you have any questions that have not been answered by this document, or if you notice changes that need to be made, please contact Doug Brooks at USACERL, P.O. Box 4005, Champaign, Illinois 61824-4005, 217/373-6752.

Table of Contents

1. Background

The Geographic Resources Analysis Support System (GRASS) is a geographic information and image processing system. It was originally designed from user requests to serve land managers and environmental planners at army installations. GRASS is written in "C" on computers running the UNIX operating system. One reason UNIX was selected was the portability of code between computers.

GRASS is developed on Sun Microsystems computers initially and ported to other UNIX machines. New ports are being done as well and may not be included in this version of the Guide. Specific information on ports and configurations, other than those listed in this document, is available from the GRASS Information Center.

2. Minimum Configuration

1) Processor running UNIX or similar operating system.

   GRASS was written in a UNIX environment to ensure its portability rather than limit users to a single brand of hardware. Within GRASS, there are many processor intensive functions. Therefore, processor performance should be a consideration.

2) Virtual Memory

   Virtual Memory is necessary for performance. Virtual Memory is a feature that utilizes a section of hard disk as 'swap space'. When large programs call for more System Memory than is actually available, virtual memory utilizes swap space as temporary storage to swap out data that is currently using memory to free up enough System memory as is needed to run the program.

3) Graphics Library

   The system should have a compiled graphics library such as GKS or Sigcore.

4) System Memory

   System Memory should be at least 4 megabytes.

5) Color Graphics Monitor

   The color monitor is important for displaying the graphic data, maps, and imagery. It should have a minimum of 256 color display. It is used in conjunction with a mouse. Some systems allow more than 1 color monitor to be utilized by the same processor, although additional monitors will be competing for CPU time.

6) Alphanumeric Monitor (CRT, terminal)

   The CRT is used to enter GRASS commands. This keeps the entire screen of the color monitor available for graphic display.

7) Mouse Pointing Device

   A mouse is used as a screen pointing device to input new data, select windows, identify features of interest, etc.

8) Hard Disk Drive

   This is where your software and data will reside and should be catered to your particular requirements. The more data you need immediately available (not on tape) the more disk you will require. 140 Mb will support GRASS for small data sets, but 300 Mb of storage is recommended as a minimum.

9) Tape Drive (1/2 inch or 1/4 inch)

   Some device is required for backups, data input, and software acquisition. A 1/2 inch tape drive is especially useful for reading imagery tapes and transferring data between sites.

3. Peripheral & Performance Enhancement Options

1) Color Graphics Printer

   Generate color printouts for use away from the graphic monitor. (Required to obtain 'Paint' output)

2) Line Printer

   Print out text and tabular information.

3) Additional system memory

   Provides increased performance.

4) Floating Point Processor

Provides increased performance.

5) Modem(s)

Provides the ability to link to external sources such as GRASSNET, transfer data over phone lines, support remote users, etc.

6) Digitizer

Allows input of detailed data from hardcopy (printed) maps. (e.g. from U.S. Geological Survey maps)

7) 1/2 Inch Tape Drive (if not purchased with basic system)

Especially useful for reading imagery tapes. (NOTE: Not all models of computer systems support this type of drive)

8) Additional Terminals as desired

4. Other Considerations

1) Temperature Factors

All computers generate heat. If the room in which the computer resides becomes too warm the computer will become distressed. As a result, air conditioning and environmental control are important factors to consider.

2) Surge Protection

Power fluctuation is another threat to computers. If the power in the line to which the computer will be plugged in fluctuates, it may be necessary to have surge protection.

3) Power Requirements

Power requirements for computers vary. Some smaller systems can run with existing standard 110v outlets. Other larger systems may require dedicated 30 amp outlets. Check with the vendors you are considering regarding special power requirements for their products.

4) Telephone Lines

Access to dedicated telephone lines is important for those who wish to be in contact with outside services such as GRASSNET (a network of GRASS user sites), or to get electronic mail from remote computers.

5. Hardware Configuration Criteria

Before hardware can be included in this GRASS Hardware Configuration Guide, it first must meet following criteria:

1) Hardware Compatibility

The hardware must be compatible with the GRASS software. This includes successfully working with all aspects of the GRASS software package. This compatibility must be determined by USACERL or an authorized support center.

2) Hardware Support

The equipment must be supported by an authorized support center or USACERL. This support must be made available to the entire GRASS user population and not limited to a specific segment of users.

An authorized support center is an agency who has established a working agreement with USACERL to support certain lines of computer equipment. Support centers are generally instituted corresponding to the manufacturer of the computer system and not the peripherals, although there may be exceptions.

6. GRASS Support Centers

The support centers that currently exist are listed here along with the computer systems and/or specific agencies that they support.

Support Center	Systems and/or Agencies
DBA Systems Redwood One Building 10560 Arrowhead Drive Fairfax, VA 22030 (703) 591-0800	Sun, Tektronix, PC 386
G.W. Hannaway & Associates 839 Pearl Street Boulder, CO 80302 (303) 440-9631	Silicon Graphics
ITD Space Remote Sensing Center Attn: Quinn Houchin Building 1103, Suite 118 Stennis Space Center, MS 39529 (601) 688-2509	MASSCOMP, Macintosh, AT&T
Technology & Services Group 3649 Cherbourg Road Marietta, GA 30062 (404) 578-0531	Data General, Intergraph
National Park Service Attn: Harvey Fleet GIS Division P.O. Box 25287 Denver, CO 80225 (303) 969-2590	NPS agencies only
USACERL P.O. Box 4005 Champaign, IL 61824-4005 (217) 352-6511, ext. 414	U.S. Army/COE agencies only
USDA Soil Conservation Service Attn: Richard Francek National Cartographic Center P.O. Box 6567 Ft. Worth, TX 76115 (817) 334-5212	SCS agencies only
U.S. Geological Survey Attn: Edward Eskowitz Mail Stop 915 National Center 12201 Sunrise Valley Dr. Reston, VA 22092 (703) 648-6505	USGS Agencies only

7. Supported Configurations

This section contains information about systems that are currently supported by an authorized support center and have successfully completed a Beta test as outlined by USA-CERL.

Sample configurations have been included in this section for you to use as a reference when considering the purchase of new hardware.

7.1. MASSCOMP CONFIGURATION

Manufacturer

Concurrent Computer Corp.
106 Apple Street
Tilton Falls, NJ 07724
(201) 870-4500

GRASS Software Distribution

Space Remote Sensing Center
Attn: Quinn Houchin
Building 1103, Suite 118
Stennis Space Center, MS 39529
(601) 688-2509

Entry Level Configuration

Item	Description	Item #	List	GSA
MC6300	68030 processor	6300-1-P1-0	24,900	19,920
	68882 Co-Processor			
	8 Mb memory			
	RTU Operating System			
	16" GA1000 Color Terminal	GC-46	7,500	6,150
	12 bit-plane graphics	GM-918	5,000	4,100
	318 Mb hard disk	D-5N318	8,000	6,560
	150MB 1/4" tape cartridge	TD-150	2,100	1,722
	5 1/4" floppy drive			
	Ascii Terminal		400	400
	Total		$ 47,900	$ 38,852

Up to three GA1000 Graphics Terminals may be attached to the MC6300. The terminals can be up to 150' away from the MC6300 by using an optional cable.

Also, the MC6300 can support up to three CPU's each with it's own Lightning Floating Point Accelerator Board.

7.2. SUN CONFIGURATIONS

Manufacturer

Sun Microsystems, Inc.
2550 Garcia Avenue
Mountain View, CA 94043
(415) 960-1300
(800) 821-4643

GRASS Software Distribution

DBA Systems
Attn: Dave Johnson
Redwood One Building
10560 Arrowhead Drive
Fairfax, VA 22030
(703) 591-0800

SPARCstation 1 Configuration

Item	Description	List	GSA
4-60FC-8	SPARCstation 1 Processor Floating Point Accelerator 8 Mb memory 16" color monitor 8 bit-plane graphics	12,495	9,746
X539H	327 Mb hard disk w/ 1/4" tape cartridge	7,000	5,810
	Ascii terminal**	400	400
SS2-07	SunOS Software	250	195
SS-09	Sun-4, SPARCstation 1 Documentation	450	312
X301H	USA Country Kit	n/c	n/c
SYS-L2	2-user Operating License	n/c	n/c
	Total	$ 20,595	$ 16,463

386i Configuration

Item	Description	List	GSA
RR250C-8	Sun 386i with 80386 Processor @ 25MHz 80387 Coprocessor @ 25MHz 8MB Main Memory (expandable to 16MB) 19" Color Monitor	22,990	14,812
RR154	327 MB Hard Disk		5,478
SR1-03	SunOS 4.0 Operating System	550	429
FOR-1.1-4-R-5	Sun Fortran Software	1,200	780
RR127	Expansion Unit	2,000	558
RR132	60 MB, 1/4" tape drive		1,233
SYSL2	2-User License		N/C
	Total	$ 26,740	$ 23,290

** This item is not supplied by Sun Microsystems but is readily available from a variety of sources for approximately $400

7.3. AT&T CONFIGURATIONS

Manufacturer

AT&T Corporation

GRASS Software Distribution

USDA Soil Conservation Service (USDA Agencies only)
Cartography & GIS Division
Attn: Richard Liston
P.O. Box 2890
Washington, DC 20013
(202) 447-5411

AT&T 6386 Configuration

Description	GSA
AT&T 6386E WGS Computer with 80386 processor w/ 2 MB RAM 135 MB Hard Disk DOS 3.2	5,823
80387 20MHz Coprocessor	791
2 MB Memory Expansion Kit	746
60 MB, 1/4" Tape Drive	995
AT&T 3-Button Mouse	100
Orchid Designer VGA Model 800 w/ Pro-Designer VGA Upgrade Kit	550
NEC Multisync Plus monitor	800
Ascii Terminal w/vt100 emulation	500
8-port Serial Board	500
Total	$ 10,805

AT&T 3B2 Configuration

Description
AT&T 3B2 w/ (2) 72MB Hard Disks, 4MB Memory, C Compiler, 1/4" Tape Drive, Math Co-Processor. 1 Parallel Port & 4 Serial Ports
AT&T PC6300 w/ 20MB Hard Disk, 360KB Floppy Disk, 1 Parallel Port, 1 Serial Port, & Graphics Card
REQUIRED ACCESSORIES: Keyboard, 128K Chip Set, 256K Memory Bd., RGB (318) Color Monitor, Mouse 6300 (2-button), & MS-DOS/GW Basic

7.4. PC 386 CONFIGURATION

Due to the compatibility of computer systems with the MS-DOS world there are a large number of vendors that can supply you with the basic 386 personal computer that will work in place of the brand of computer listed below. The configuration listed here is the basis for the initial port of GRASS to give you an idea of what is needed.

This is not meant as an endorsement of Compaq above any other vendor.

Manufacturer

Compaq Computer Corporation
P.O. Box 692000
Houston, TX 77069-2000

GRASS Software Distribution

DBA Systems
Attn: Dave Johnson
Redwood One Building
10560 Arrowhead Drive
Fairfax, VA 22030
(703) 591-0800

PC 386 Configuration

Description	List
Compaq Deskpro 386/20 with 300 Mbyte Hard Disk, 1 Mbyte RAM & 1.2 Mbyte Floppy Disk	8,874
80387 Math Co-processor (20 MHz)	851
4 Mbyte Expansion Memory	1,490
Compaq MS-DOS 3.31	85
Everex 1/4" Tape Backup Unit	900
NEC Multisync II Monitor	600
Orchid Designer 800 (VGA) with 512K Memory Upgrade Option	565
Logitech 3-button Bus Mouse	150
4-port Intelligent Serial Card	1,000
Interactive Systems UNIX	595
Ascii Terminal	500
Total	$ 15,610

7.5. SILICON GRAPHICS IRIS 4D/20 CONFIGURATION

Manufacturer

Silicon Graphics
2011 N. Shoreline Blvd.
Mountain View, CA 94043
(415) 960-1980

GRASS Software Distribution

G.W. Hannaway & Associates
Attn: Wyndham Hannaway
839 Pearl Street
Boulder, CO 80302
(303) 440-9631

Beta Configuration

Description	List	GSA
Silicon Graphics IRIS Model 4D/20	22,400	17,248
8 Mbyte RAM		
170 Mbyte Hard Disk		
150 Mbyte 1/4" Tape Backup		
19", 12 bit Monitor		
Ethernet Card		
UNIX System V.3 w/ Berkeley Enhancements		
Media & Manuals		
C Compiler	500	500
Total	$ 22,900	$ 17,748

8. Beta Configurations

Several systems are currently being evaluated for use with GRASS. This section has been added in order to list the configurations of systems that have successfully completed Alpha testing and are currently undergoing Beta test.

Beta test guidelines have been outlined by USACERL and all new systems must undergo this process. Once a configuration has successfully completed Beta test and an authorized support center has agreed to support this product, that configuration will then be moved to Section 7, 'Supported Configurations'. This document "Testing Guidelines for GRASS Ports and Drivers" can be obtained from the GRASS Information Center.

Beta configurations are listed along with the coordinator that is heading up the Beta test. For more information on a particular configuration, please contact the person(s) listed.

8.1. INTERGRAPH InterPro 340 Configuration

Manufacturer

Intergraph Corporation
Attn: Gary Lambert
One Madison Industrial Park
Huntsville, AL 35807-4201

Beta Test Coordinator

USACERL
Attn: Victoria Harmon
P.O. Box 4005
Champaign, IL 61824-4005
(217) 352-6511, ext. 588

Beta Configuration

Description	GSA	Part No.	Price
Intergraph InterPro 340 w/ 8 Mbyte RAM, w/ 19", 9 bit-plane Monitor & GX Graphics Board, w/ 156 Mbyte Internal Hard Disk, w/ Fairchild System V.3 software,mouse,FMU,XNS	yes	DSP211	$31,134.00
355 Mbyte External Hard Disk			$5,100.00
UNIX System V.3 Manuals	yes	DSYSO78	$200.00
C Compiler	no	SSS0010	1,200.00
1/4" Cartridge Tape Backup System	yes	MTPO53	$1,946.00
Total			$39,580.00

8.2. Apple MacII Configuration

Manufacturer

Apple Computers
Mike Gunville
20525 Mariani Ave., Mail Stop 63-B
Cupertino, CA 95014
(408) 974-8260

Beta Test Coordinator

Space Remote Sensing Center
Attn: David Lewis
Building 1103, Suite 118
Stennis Space Center, MS 39529
(601) 688-2509

Beta Configuration

Description	List
Apple Mac II Computer w/ 68881 co-processor & 5 Mbyte RAM	4,896
Extended Keyboard	299
80 Mbyte A/UX Hard Disk	2,582
A/UX Documentation	649
80 Mbyte External Hard Disk	2,199
Apple High Resolution Monitor	999
8 bit Video Card	648
Page Memory Management Unit (PMMU)	499
40 MByte Tape Drive	1,579
Ascii Terminal	500
Media & Manuals	
Total	$ 14,850

Optional Equipment

Description	List
2 Mbyte Memory Expansion	1,199
Ethernet Card	699
Mac IIx CPU (68030 w/ 68882 co-processor & PMMU)	7,769
Apple ImageWriter	629
Apple ImageWriter (Color)	1,429

8.3. TEKTRONIX CONFIGURATION

Manufacturer

Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075
(800) 547-1512

Beta Test Coordinator

DBA Systems
Attn: Dave Johnson
Redwood One Building
10560 Arrowhead Drive
Fairfax, VA 22030
(703) 591-0800

Beta Configuration

Item	Description	List
4324	2-D Graphic Workstation 68020 Processor @ 20MHz 68881 Coprocessor 4MB Main Memory (expandable to 12MB) 68020 Graphics Processor @ 16MHz 8 bit-plane display memory	19,950
Option 12	60MB 1/4" Streamer Tape	2,000
Option 17	300MB Hard Disk	5,500
Option 32	19" Display (1024x768)	1,500
	Total	$ 28,950

8.4. HEWLETT PACKARD 9000 CONFIGURATION

Manufacturer

Hewlett Packard

Beta Test Coordinator

USGS, Branch of Geophysics
Attn: Joe Plesha
Mail Stop 964, Box 25046
Denver Federal Center
Denver, CO 80225
(303) 236-1410

Beta Configuration

Item	Description	List
	68030 processor (33 MHz)	
	8MB memory, 8MB Ram (16MB total)	
98550A	16" or 19" Color Monitor	
	8 bit-planes (w/ 2 overlay planes)	
	1280 x 1024 screen resolution	
	HP 98547A video card/high resolution color card	
46060B	Keyboard, HPIL 3-button mouse	
	1/4" cartridge tape drive	
	Total	$

9. PRINTERS

Some of the printers have comment sections. These comments are based on actual USACERL experience.

Model: Epson LQ-2500

Manufacturer:

Epson America, Inc.
2780 Lomita Blvd.
Torrence, CA 90505
(213) 539-9140

Availability: Most local computer stores

List Price: $1599

Specifications:

technology - 4 color ribbon, dot matrix, impact
comparative speed - 21 minutes
maintenance - dense color mapping can cause rapid deterioration of ink ribbon. Frequent (1 to 2 months) replacements may be needed.
supplies - standard width (14 inch) tractor feed paper, color ink ribbons
connection - serial or parallel
resolution - 90 dpi

Model: Shinko CHC-635

Manufacturer:

Shinko Electric Co., Ltd.
%Mitsubishi, International
520 Madison Avenue
New York, NY 10022
(212) 605-2000

Availability: Directly from Mitsubishi

List Price: $9,990

Specifications:

technology - 3 color ribbon, thermal transfer
comparative speed - 15 to 25 minutes
maintenance - frequent replacement of ink ribbon and paper (70 copies)
supplies - thermal transfer ribbons & thermal paper
connection - centronics parallel
resolution - 200 dpi
comment: The Shinko printer actually prints the page in 2 - 3 minutes but is slowed to 15 - 25 minutes due to the necessity of intensive software manipulation by the 'Paint' program. The color image must be split into 3 separate overlays and then sent to the printer in the correct order.

Model: Tektronix 4696

Manufacturer:

Tektronix, Inc.
Information Display Group
Graphic Printing and Imaging Div.
Wilsonville Industrial Park
P.O. Box 1000
Wilsonville, OR 97070

Availability: Most local computer stores

List Price: $1795

Specifications:

technology - 4 color ink-jet
comparative speed - 25 minutes
maintenance - 5cc color reservoirs may require frequent refills when used for large mapping projects.
supplies - special 10 inch paper(wax coated), special mylar sheets, color ink refill cartridges.
connection - parallel
resolution - 120 dpi

Model: Genicom 3310 Color

Manufacturer:

Genicom Corp.
Waynesboro, VA 22980
(703) 949-1000

Availability: Most local computer stores

List Price: $2295

Specifications:

technology - 4 color ribbon, dot matrix, impact
comparative speed - 7 minutes (quality 1), 26 minutes (quality 3)
maintenance - dense color mapping can cause rapid deterioration of ink ribbon. Frequent replacements may be needed.
supplies - standard width (14 inch) tractor feed paper, color ink ribbons
connection - serial or parallel
resolution - 36 dpi (quality 1), 72 dpi (quality 3)

10. DIGITIZERS

Manufacturer:

ALTEK Corporation
12210 Plum Orchard Drive
Silver Spring, MD 20904-7802
(301) 572-2555

Specifications:

Accuracy - +/- .010" (.005", .003" - optional)
Connection- RS232 Serial Interface
Resolution - .001"

A sample configuration is listed showing a 36" x 48" non-backlit (opaque) table with an accuracy of +/- .010". An electric height, manual tilt base has also been included. The base is optional but with this size of table it is highly recommended.

Item #	Description	List	GSA
ACC16	Cursor	360.00	324.00
AC30	Basic Controller	450.00	405.00
AC30PS02	Power Supply	125.00	112.50
ACDTB	Digitizer Mounting Base, Electric Height, Manual Tilt	1,150.00	1,035.00
ACT36048-1NB	36" x 48" Digitizer	3,370.00	3,033.00
	TOTAL	$5,455.00	$4,909.50

Altek provides several options with their equipment such as tables with higher accuracies of +/- .005" and +/- .003", backlit versions and various sizes of tables ranging from 12" x 12" up to 60" x 90". Some of these are listed here. The 42" x 60" backlit table requires an ACDTB-T Electric Height, Electric Tilt base.

Item #	Description	List	GSA
ACT24036-1NB	24" x 36" Digitizer, Non-Backlit	2,990.00	2,691.00
ACT24036-1BL	24" x 36" Digitizer, Backlit	4,230.00	3,807.00
ACT36048-1BL	36" x 48" Digitizer, Backlit	5,600.00	5,040.00
ACT42060-1NB	42" x 60" Digitizer, Non-Backlit	4,100.00	3,690.00
ACT42060-1BL	42" x 60" Digitizer, Backlit	7,075.00	6,367.50

Manufacturer:

CalComp Inc.
2411 West LaPalma Avenue
Anaheim, CA 92801
(714) 821-2872

Specifications:

Accuracy - +/- .010"
Connection- RS232 Serial Interface
Resolution - 1,279 Lines per Inch

Item	Description	List	GSA
91480	36"x48" Surface w/ Control Electronics		3,146
91004	RS-232 Single Port DTE		241
91036	16-Button Cursor		283
91053	120V Power Supply		189
91082	Cursor Holder		51
91070	Power Base		951
	Total		4,861

Manufacturer:

Kurta Corporation
4610 South 35th Street
Phoenix, AZ 85040
(602) 276-5533

Specifications:

Model - Series Three
Accuracy - +/- .010"
Connection- RS232 Serial Interface
Cursor - 16 button (Driver uses cursor buttons)
Resolution - 1000 PPI (Points Per Inch)
Type - Tablet with electronics
Prices:

Description	List	GSA
30 x 36 Tablet	$4,195	NA
36 x 48 Tablet	$4,895	NA
42 x 60 Tablet	$5,995	NA

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